



# Technology Demonstration Fact Sheet

## Lead “TechXtract” Chemical Decontamination



### SUMMARY

The Hanford Site C Reactor Technology Demonstration Group demonstrated lead brick decontamination using the TechXtract® chemical decontamination process. The demonstration indicated that the technology could achieve high decontamination factors and could reduce radioactivity to below published surface “free release” requirements. Out of 80 bricks decontaminated, 78 bricks achieved background or non-detectable levels. Active Environmental Technologies (Mt. Holly, NJ) performed a production-scale demonstration of the TechXtract® technology on radioactively contaminated lead bricks at the C Reactor at the Hanford Site in Richland, Washington.

Performance of the improved technology demonstration versus the baseline demonstration was as follows:

- Production throughput rates of over 200 bricks per 5-hour day with 97% becoming releasable
- Decontamination factors ranging up to over 182
- Decontamination was performed in a safe work place environment with improved ALARA practice
- Secondary waste production of only 0.01 gallons per brick or 6 pounds per ton processed

### INNOVATIVE TECHNOLOGY DESCRIPTION

The TechXtract® technology is a sequential chemical extraction process for the removal of radionuclides, PCBs, and other hazardous organic and inorganic substances from solid materials such as concrete, brick, and steel. The technology uses chemical formulations and engineered applications to achieve significant penetration and removal of these contaminants from at and below the surface of these materials.

The TechXtract® chemistry is based on hypotheses relating to contaminant migration and removal: Contaminants migrate into the pores and microscopic voids of a material, even for seemingly non-porous media. Mobility of the contaminants, time, and electrostatic forces often drive these contaminants to deeper levels in the substrate. Furthermore, the contaminants tend to become chemically or electrostatically bonded to the substrate. In many cases, the time between the contamination event and decontamination efforts will allow the contaminant migration pathways to become partially closed.

The chemical extraction is designed to achieve the following:

- Reopen the pores and capillary pathways to the maximum possible extent
- Penetrate into the pores as deeply as possible
- Break the substrate and contaminant bonds that may be holding the contaminants in place
- Bind or sequester the contaminants in the chemical solution to prevent recontamination.

The TechXtract® chemical formulas address each of these complex needs, using components that incorporate dissolution, oxidation, reduction, hydrolysis, wetting, complexation, microencapsulation, and flotation chemistry principles. The chemistry further compensates for situations in which the contamination is a mixture of pure elements, oxides, and related compounds with varying solubility indices. The spent chemical solutions do not contain any hazardous constituents (except for extracted contaminants) and have been disposed of by incineration, solidification (and land disposal), and discharge to liquid effluent treatment systems.

In most projects, up to three different chemical formulas are used in sequence. Chemicals can be applied in low volumes, as a spray or dip, to minimize consumption and secondary waste volume. After being applied, the chemicals are scrubbed into the contaminated surfaces with sonication for a defined time, and rinsed and removed with vacuum.

### BASELINE TECHNOLOGY DESCRIPTION

The baseline for the disposition of lead is encapsulation and disposal at the Hanford Site Environmental Restoration Disposal Facility (ERDF). Encapsulation consists of surrounding the lead in a concrete matrix with each package measuring 48 inches square and 15 inches thick, holding 3,500 pounds of lead.

## DEMONSTRATION DESCRIPTION

A 16 x 8 foot trailer contains material handling, decontamination, and waste handling systems. All interior vertical and horizontal surfaces are covered with welded, seamless, 4-mil HDPE for easy decontamination. The trailer also protects the workers and equipment from weather and provides secondary containment for the TechXtract™ baths. The normal work crew for the unit is two persons, a technician and supervisor. The trailer's power requirement is for 120v, 60Hz, 45 amps, which can be provided externally or with an onboard generator. All bricks were 2"x4"x8" and were limited to activity levels less than 800,000 dpm/100cm<sup>2</sup>.

**Material Handling System:** Bricks were decontaminated in batches of four. The individual bricks were placed into baskets constructed from non-reactive materials. Batches were staged at the open end of the trailer where the baskets are loaded and then lifted by means of a light rail hoist. The hoist's I-beam and manual hoist construction has a lift capacity of 200 pounds. The I-beam rail runs in a circuit along the ceiling of the trailer and outside for loading and unloading baskets.

**Decontamination Systems:** The decontamination stations inside the trailer consist of three ultrasonic baths, two rinse station, and a final drying vacuum station. The ultrasonic baths are heated, thermostatically controlled, and measure 20" x 11.5" x 11". TechXtract solutions act as the ultrasonic cleaning medium. Batch dwell time is a maximum of 15 minutes per station with the capability to run simultaneous batches, giving a minimum production capacity of 16 bricks per hour. The decontamination steps progress as a series of tank dipping operations. The actual dwell time was 7 minutes/bath for 13 batches and 5 minutes/bath for 7 batches. All but two (2) bricks were free released. With the lower dwell time, the initial batch takes 30 minutes, and then sequential batches exit the process every 5 minutes.

**Waste Liquids System:** Waste contaminated liquids were removed using two (2) vacuum systems with HEPA filters on the exhaust side. Wastes were captured in the vacuum drum and transferred later to a disposal drum. Stabilization agents were added to form a solid waste.

## DETAILS OF BENEFITS

- Production throughput rates of over 200 bricks per day
- Decontamination factors ranging to over 182
- Decontamination was performed in a safe work place environment with equipment that was readily surveyed and decontaminated
- Secondary liquid waste production of only 0.01 gallons per brick or 6 pounds per ton processed

## SUCCESS CRITERIA

- A very high percentage of cleaned bricks must be releasable per surface release criteria
- A safe work place environment for decontamination
- Simple to deploy, requiring some skill levels
- Production rate to be large scale -- at least 100 bricks per day

**Table 1. Performance**

Setup/warm-up	Approximately 1 hour
Crew Size	2 D&D Workers + 1 RCT
Production Rate *	48 bricks/hr (1248#/hr)
Final Survey Time	23 seconds per brick + wipes
Bricks not released	3%
Liquid Secondary Waste	6 lb per ton of lead

\*Decontamination rate was a batch of 4 bricks every 5 minutes with a 5 minute dwell times/bath, where each brick weighs 26 pounds

## SCHEDULE

The innovative technology demonstration was conducted May 8 and 13, 1998 and is presently being evaluated for cost as compared to the baseline.

## FUTURE APPLICABILITY

The demonstration showed that the basic concept and design of the trailer was sound in that the demonstration's production and decontamination goals were exceeded. Continuous monitoring of the workplace during the demonstration also showed that the process was safe from a worker exposure perspective. ALARA and safety considerations were also met, because the process does not use aggressive surface ablation techniques. Refinements that could be made to either the mechanical or chemical features of the system include the following items:

- Addition of an exhaust HEPA ventilation system to the trailer to allow more highly contaminated bricks to be processed
- Automate the manual hoist system
- Explore shorter dwell times and or elimination of one step in the dipping process in order to increase throughput
- Adapt the brick holders to process other metal items such as tools.

## CONTACT PERSONS

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